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ABSTRACT

This study tested the hypothesis that the relationship between self-image and achievement would show different developmental patterns for boys and girls, particularly with regard to the relationship between self-image and mathematics and science achievement. Subjects were selected from two successive sixth grade cohorts in two predominantly white, middle class suburban school districts, and followed through the eighth grade. Two-hundred fifty-three students were included in the study. Covariance structure (LISREL) analysis was performed to examine gender relationships between academic achievement (as measured by course grades) and self-image (as measured by the Self-Image Questionnaire for Young Adolescents). The results of cross-sectional tests revealed that there was a significantly stronger relationship between self-image and academic achievement for boys than for girls in sixth and seventh grade, particularly with regard to mathematics and science achievement. Longitudinal tests, within gender, showed that the relationship between self-image and achievement increased for boys and decreased for girls when they moved from sixth to seventh grade. A series of repeated measures revealed a positive relationship between self-image and high mathematics achievement among boys, and a negative relationship among girls. (Author/TW)

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GENDER DIFFERENTIAL DEVELOPMENTAL CHANGE IN THE ACHIEVEMENT-SELF-IMAGE RELATIONSHIP OVER EARLY ADOLESCENCE

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Abstract

This study tested the hypothesis that the relationship between self-image and achievement would show different developmental patterns for boys and girls, particularly with regard to the relationship between self-image and mathematics and science achievement. Subjects were selected from two successive sixth grade cohorts in two predominantly white, middle class suburban school districts, and followed through eighth grade. Two hundred fifty three students were included in the study. Covariance structure (LISREL) analyses were performed to examine gender differences in the patterns of relationship between academic achievement (as measured by course grades) and self-image (as measured by the Self-Image Questionnaire for Young Adolescents). The results of cross-sectional tests revealed that there was a significantly stronger relationship between self-image and academic achievement for boys than for girls in sixth and seventh grade, particularly with regard to mathematics and science achievement. Longitudinal tests, within gender, showed that the relationship between self-image and achievement increased for boys and decreased for girls when they moved from sixth to seventh grade. A series of repeated measures MANOVAs revealed a positive relationship between self-image and high mathematics achievement among boys, and a negative relationship among girls. Implications for the increased salience of gender as an organizer of behavior during early

adolescence and for the development of gender differences in mathematics and science participation are discussed.

GENDER DIFFERENCES IN ACHIEVEMENT BEHAVIOR DURING ADOLESCENCE

Marked gender differences in achievement behavior emerge in early adolescence. The work of Stein and Bailey (1973) showed that attainment values and standards of performance become sex-typed. Gender differences are especially marked with mathematics achievement which is considered to be a male stereotyped domain and with science achievement, because mathematical skills are necessary for science achievement.

The gender differences in achievement values are especially interesting given the lack of performance differences at this age. A research team headed by Marlaine Lockheed (1985) conducted a review of the literature on gender differences in mathematics and science performance among boys and girls in grades four to eight. They concluded, that there were few gender differences in science performance and "few--if any--consistent [gender] differences in mathematics performance on the types of mathematics skills taught in grades four to eight." Overall, girls are likely to earn higher course grades than boys. Therefore, the gender differences in valuing achievement, especially in mathematics and science, are unlikely to be based on lower performance of girls. Instead, they may be due to different socialization experiences.

GENDER DIFFERENCES IN THE RELATIONSHIP OF ACHIEVEMENT TO SELF-IMAGE

Research on the achievement-self-image relationship among children and adolescents has suggested that the relationship develops differently for boys and girls over time. Among children the achievement-self-image relationship is generally positive for both boys and girls, with some evidence of a stronger relationship among girls. However, during early and middle adolescence the achievement-self-image relationship is strong and positive for boys, but not girls. Moreover, for girls there is evidence of a negative relationship between self-image and mathematics achievement.

The present study aimed to test the hypothesis that the achievement-self-image relationship would develop differently for boys and girls through a longitudinal investigation focused on the early adolescent period, a time of demonstrated vulnerability for changes in achievement-related behavior and attitudes as a function of gender. It was expected that the achievement-self-image relationship, in general, would increase for boys and decrease for girls during early adolescence. It was also expected that high mathematics achievement among young adolescent girls would be negatively related to self-image.

METHODS

Sample

This study was part of a large longitudinal investigation of developmental change during early adolescence (Petersen, 1984). The data were collected in a cohort-sequential longitudinal design. Students were randomly selected in 1978 and 1979 from two successive sixth grade cohorts in two predominantly white, middle and upper middle class suburban school districts. Each cohort was followed from sixth through eighth grade. The subsample with all the data needed for the present study was 253 students, 140 girls and 113 boys.

Measures

Academic achievement. The instruments used in the study are summarized in Table 1. School performance measures were obtained from school records at sixth, seventh, and eighth grades. Final course grades were obtained in the five major subjects: literature, language arts, mathematics, science, and social studies.

Self-image. Self-image was assessed with the Self-Image Questionnaire for Young Adolescents (SIQYA) which included nine scales: Impulse Control(S1), Emotional Tone (S2), Body Image (S3), Peer Relationships (S4), Family Relationships (S5), Coping and Mastery (S6), Vocational-Educational Goals (S7), Psychopathology (S8), and Superior Adjustment (S9). All items and scales were scored so that higher scores indicated a more positive self-image. Information

demonstrating reliability and validity of the SIQYA is reported in Petersen, Schulenberg, Abramowitz, Offer, and Jarcho (1984).

RESULTS

The aim of this study was to test the hypothesis that the achievement-self-image relationship would develop differently for boys and girls over early adolescence. In the first set of analyses we examined gender differences in the structure and magnitude of the achievement-self-image relationship at sixth, seventh, and eighth grade. The Linear Structural Relations program, written by Joreskog and Sorbom (1986), was used to test for gender differences in the covariances between the five final course grades and the nine self-image scale scores. We were especially interested in the relationship between self-image and mathematics and science achievement.

We hypothesized that the covariance matrices would not be equivalent and that achievement and self-image would be more highly related for boys than for girls at each of the three grades. Furthermore, we hypothesized that gender differences would be especially salient with regard to the relationship between self-image and achievement in mathematics and science.

A comparison of achievement-self-image covariance structures across gender. The critical N is a test of matrix equivalence across two or more groups. It is based on the chi-square statistic, degrees of freedom, and sample size

(Hoelter, 1983). We used this index to determine if the achievement-self-image matrices were equivalent for boys and girls. Using the criterion recommended by Hoelter, the critical N indicated that the covariance matrices were not equivalent for boys and girls at sixth and seventh grade, but were equivalent at eighth grade.

Gender differences in the pattern of covariation between achievement and self-image. The normalized residuals from the LISREL analyses indicated gender differences in the pattern of covariation between achievement and self-image. The normalized residuals, distributed as z-scores, indicate those variables deviating significantly ($z>1.96$) from the general pattern of covariation. The pattern of signs of the residuals, apart from the magnitude can indicate systematic variation in deviations among the groups or parts of the data being compared. A predominance of positive residuals would indicate that the two sets of variables tend to covary more than average and negative residuals would indicate that the two sets of variables covary less than average. This information can be used to determine the relative extents to which two sets of variables are related for different samples.

The means of the normalized residuals from the tests of gender differences in the achievement-self-image covariance matrices are shown in Figure 1, by grade. For boys, the average residuals were positive at all three grades. In contrast, for girls the average residuals were negative at

all three grades. The residuals associated with the relationship between self-image and achievement in mathematics and science are also presented. The pattern of these residuals is similar to the general pattern in sixth and eighth grade, and is more extreme than the general pattern in seventh grade.

We conclude that the covariance matrices of achievement and self-image were not equivalent for boys and girls at sixth and seventh grade and that the relationship between the two sets of variables was stronger among boys. The most extreme gender differences were associated with the relationship between self-image and mathematics and science achievement at seventh grade. Although the critical N indicated that the structures of the covariance matrices of achievement and self-image were not significantly different between boys and girls at eighth grade, analysis of the normalized residuals indicated that achievement and self-image tended to covary more strongly for boys than for girls.

Next, we examined developmental changes in the achievement-self-image relationship. We hypothesized that the achievement-self-image relationship would increase among boys and decrease among girls when they moved from sixth to seventh grade. It was expected that change would be especially salient regarding the relationship between self-image and achievement in mathematics and science.

Comparisons of achievement-self-image covariance structures across grade, within gender. We performed longitudinal tests of equivalence of the achievement-self-image covariance matrices, by gender. Based on the criterion recommended by Hoelter (1983) the critical Ns indicated that the matrices were not equivalent between sixth and seventh grade for either boys or girls, and that change from grades seven to eight continued for girls but not boys.

Developmental patterns of covariation between achievement and self-image, within gender. The average normalized residuals from the longitudinal tests of matrix equivalence for boys and girls are shown in Figures 2 and 3, respectively. Examination of Figure 2 shows that, for boys, the average normalized residual was negative in sixth grade, postive in seventh grade, and negative in eighth grade. These data indicated that, for boys, there was an increase in the relationship between achievement and self-image as they moved from sixth to seventh grade and a decrease in the relationship as they moved from seventh to eighth grade. A similar, but more intense pattern of change was observed with regard to the relationship between self-image and mathematics and science achievement.

Examination of Figure 3 shows that, for girls, the average normalized residual was positive in sixth grade, negative in seventh grade, and positive in eighth grade. These data indicated that for girls the relationship between achievement and self-image decreased between sixth and

seventh grade, and increased between seventh and eighth grade. The pattern of change regarding the relationship between self-image and achievement in mathematics and science achievement was similar, but slightly stronger than the general pattern.

In summary, the longitudinal analyses showed that the relationship between achievement and self-image increased among boys, but decreased among girls as they moved from sixth to seventh grade. Between seventh and eighth grade, the relationship between achievement and self-image increased among girls and decreased, nonsignificantly, among boys. Developmental changes were especially strong with regard to the relationship between self-image and achievement in mathematics and science.

Gender differences in the relationship between self-image and high mathematics and science achievement. The final set of analyses tested the hypotheses that, among boys who dropped out of the high mathematics and science achievement groups between seventh and eighth grade, self-image would decline. However, among girls who dropped out of the high mathematics and science achievement groups between seventh and eighth grade self-image would either increase or show no change.

Students' grades in mathematics and science were trichotomized as high, average, and low. Repeated measures multivariate analyses of variance (MANOVAs) were performed to examine patterns of change in self-image for boys and

girls who dropped out of the high achievement group between seventh and eighth grade. The analyses entailed one within-subjects factor (two levels: time) and one between-subjects factor (gender).

Table 2 shows that 33% of the interactions between gender and time were significant among the students who dropped out of the high mathematics group (n=21). Tests of simple effects of time within gender showed that among boys who dropped out of the high mathematics achievement group, self-image decreased significantly on the Coping and Mastery and Superior Adjustment scales. Paradoxically, for girls who dropped out of the high mathematics achievement group, self-image increased on the Coping and Mastery and Vocational-Educational Goals scales. These patterns of interaction and the simple effects of time within gender are presented in Figure 4. In summary, mathematics achievement was positively related to self-image among boys, but negatively related to self-image among girls. The predicted patterns did not occur among students who dropped out of the high science achievement group.

DISCUSSION

Why did the achievement-self-image relationship increase among boys and decrease among girls as they moved from sixth to seventh grade? Perhaps these changes were related to changes in classroom and social environments. In most school systems students move from elementary school to junior high or middle school during early adolescence.

Eccles, Midgley, and Adler reported in 1984 that the classroom environment typically becomes more competitive, formal, and ability-centered and less personal during this time. It is suggested that young adolescent girls perceive this type of environment to be incompatible with norms for femininity, and that this conflict may explain the decline in the achievement-self-image relationship among young adolescent girls.

The young adolescent's social climate also changes in most school systems. After-school activities provide new opportunities for socializing and for some girls and boys dating begins. Research by Locksley and Douvan (1979) suggested that girls experience a conflict between popularity and achievement during adolescence, which may also help explain the decline in the achievement-self-image relationship among girls. Such an explanation would be consistent with the gender intensification hypothesis proposed by Hill and Lynch (1983), which asserted that gender becomes an important organizer of behavior during early adolescence when pubertal change begins.

Finally, we ask what consequences might have resulted from a decrease in the relationship between mathematics and science achievement and self-image for girls during early adolescence? Eccles (1984) asserted that personal needs and values operate in ways which both decrease the probability of behaving in ways that are perceived to be inconsistent with one's sense of self and increase the probability of

engaging in roles that are perceived to be consistent with one's selfview. Thus, because the relationship between mathematics and science achievement and self-image declined among girls during early adolescence, we expect that this may have posed a negative incentive for girls regarding mathematics and science participation.

Further study is needed to establish the replicability of these findings over other sets of data. Then researchers can begin to address the question of why this phenomenon occurs. We believe that a worthwhile goal of researchers and educators will be to work together to design learning environments that foster strong positive associations between achievement and success and self-image among girls and boys.

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Table 1

Instruments and Variables for Study

Academic Achievement	Self-Image
Course grades in five subjects:	Nine scales of the Self-Image Questionnaire for Young Adolescents (SIQYA):
Language Arts	Impulse Control
Literature	Emotional Tone
Mathematics	Body Image
Science	Peer Relations
Social Studies	Family Relations
	Coping and Mastery
	Vocational-Educational Goals
	Psychopathology*
	Superior Adjustment

* This scale has been reversed so that a high score indicates less psychopathology.

Table 2

Self-Image Scales Associated with Interactions Between Gender and Time Among Subjects Who Dropped Out of the High Mathematics Achievement Group Between Seventh and Eighth Grade a

Self-Image Scale
Impulse Control
Emotional Tone
Body Image
Peer Relations
Family Relations
Mastery and Coping ***
Vocational-Educational Goals **
Psychopathology
Superior Adjustment **

a n = 21

** $p<.01$, *** $p<.001$

Figure 1. Average normalized residuals from tests of gender differences in the covariance structures of self-image and academic achievement at sixth, seventh, and eighth grade. N=253

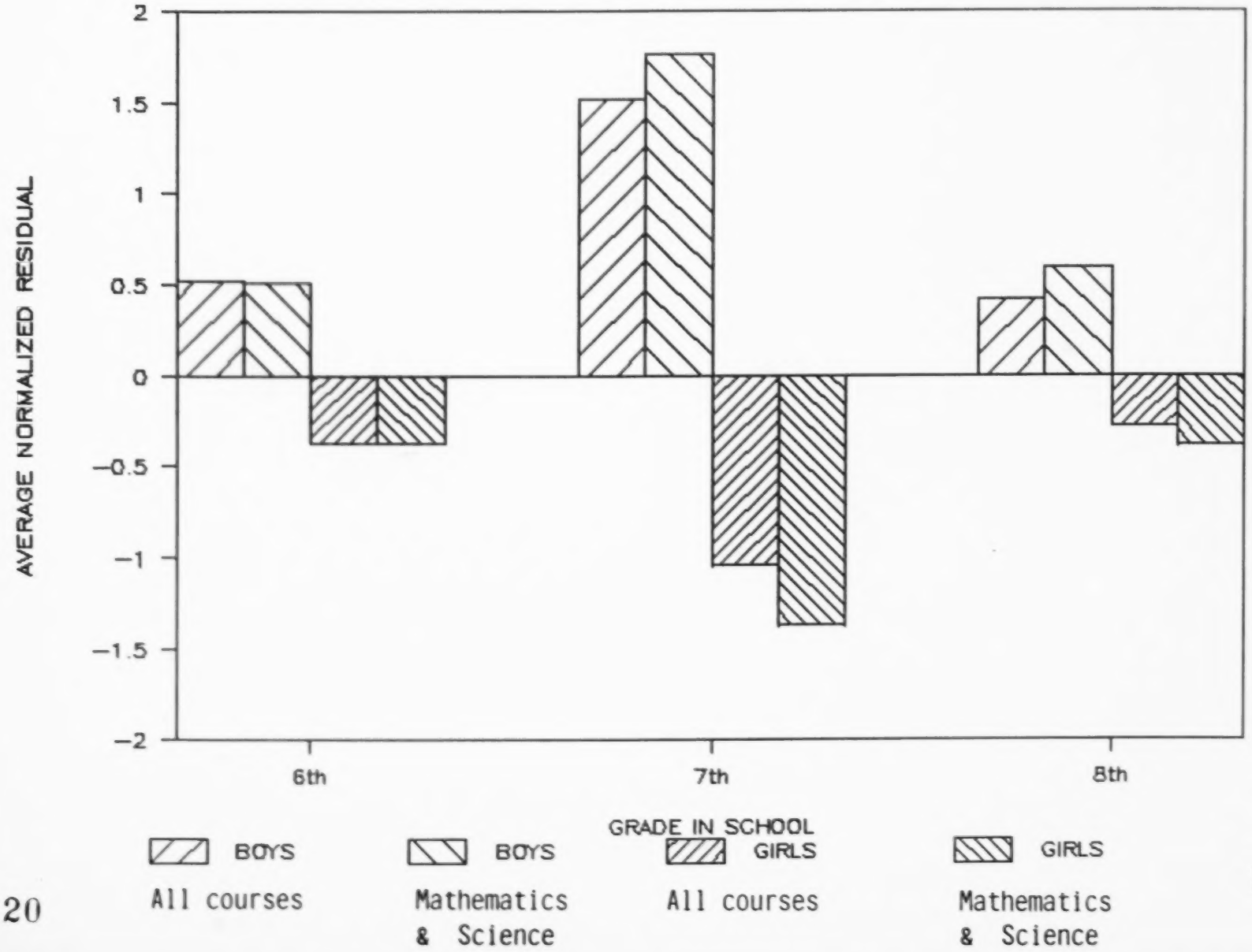


Figure 2. Average normalized residuals from a test for differences in the covariance structures of academic achievement and self-image among boys across sixth, seventh, and eighth grade. N = 113

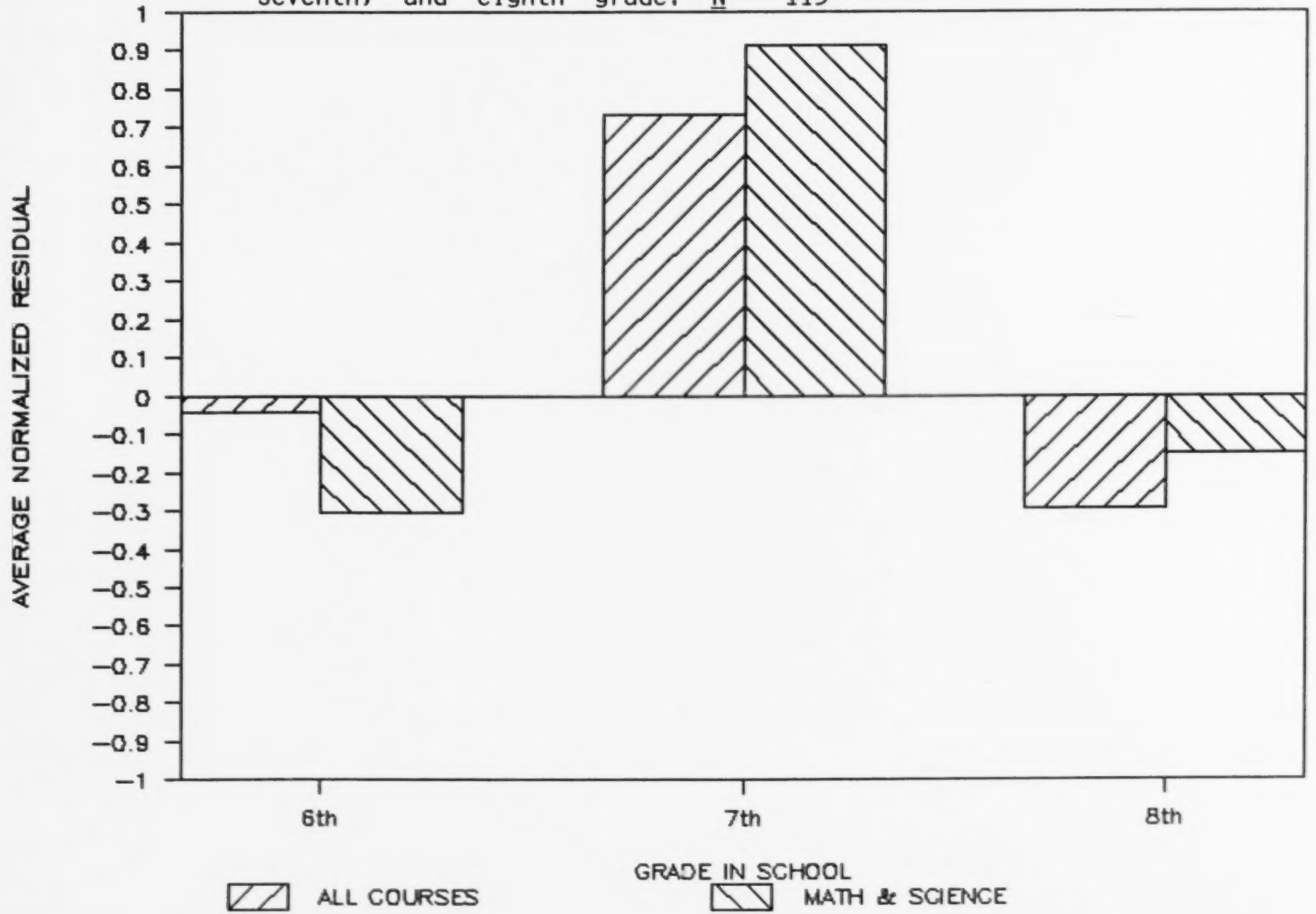
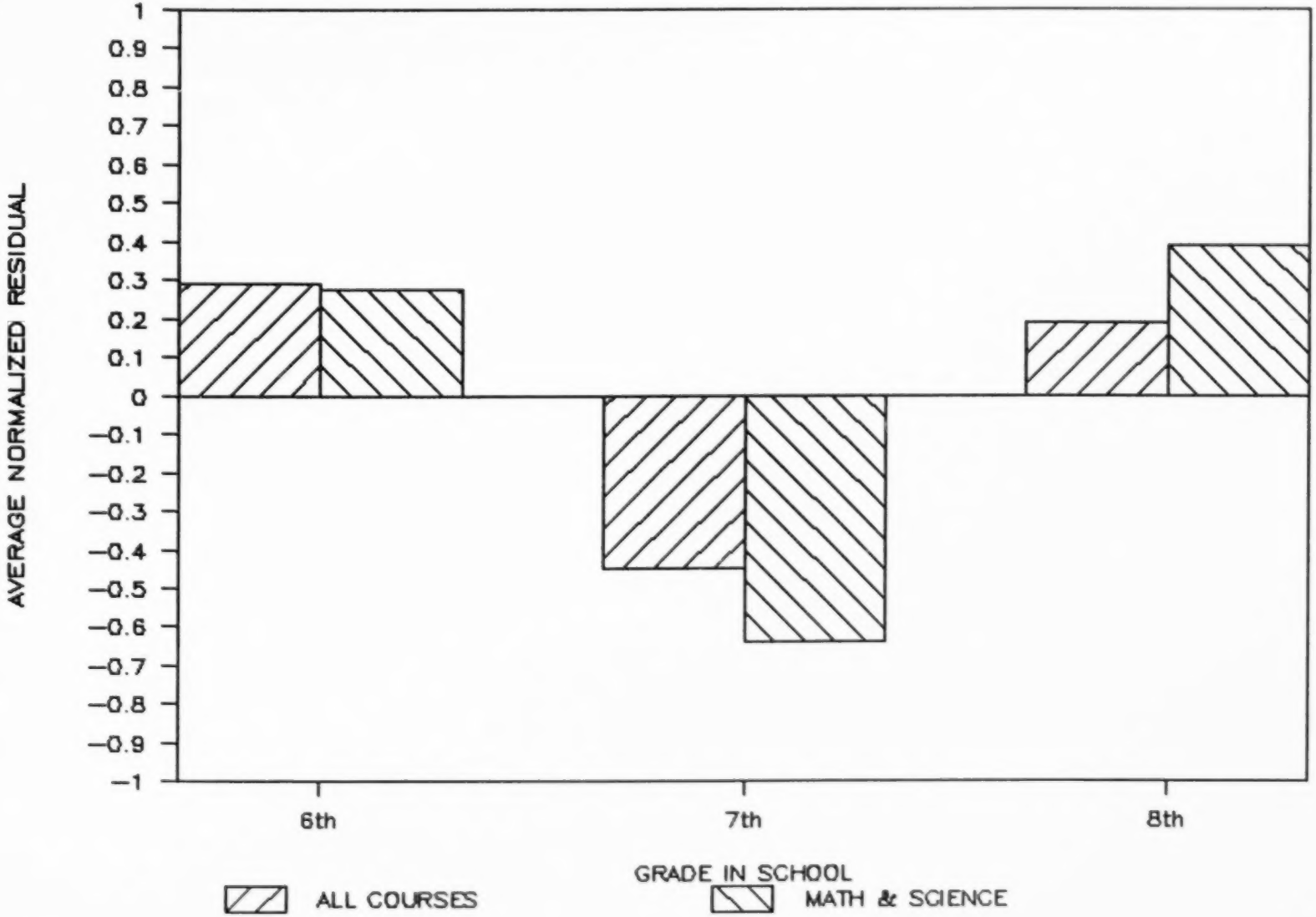
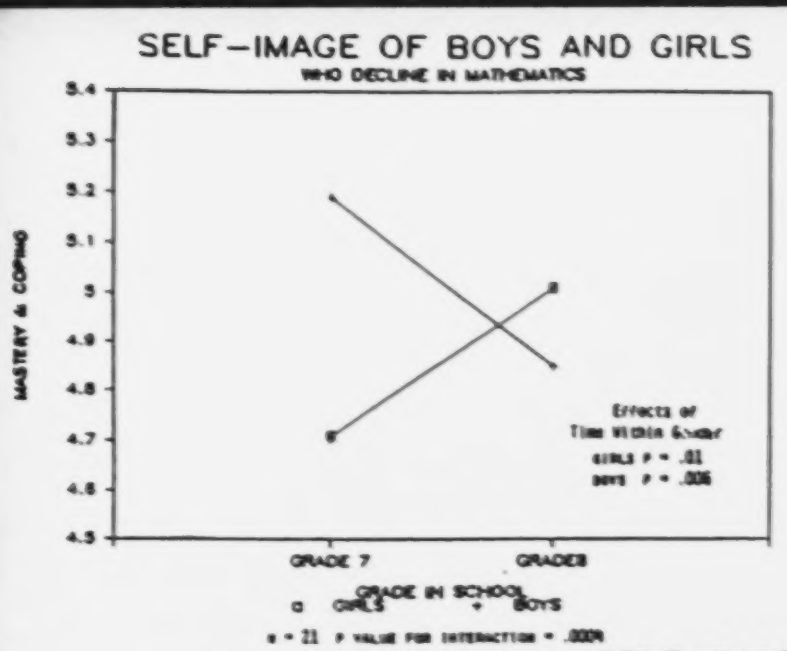
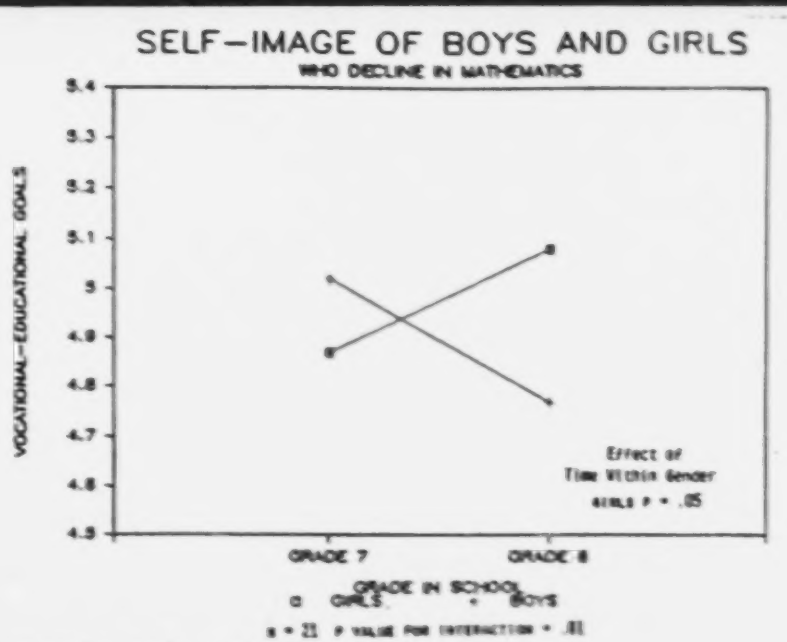


Figure 3. Average normalized residuals from a test for differences in the covariance structures of academic achievement and self-image among girls across sixth, seventh, and eighth grade. N = 140







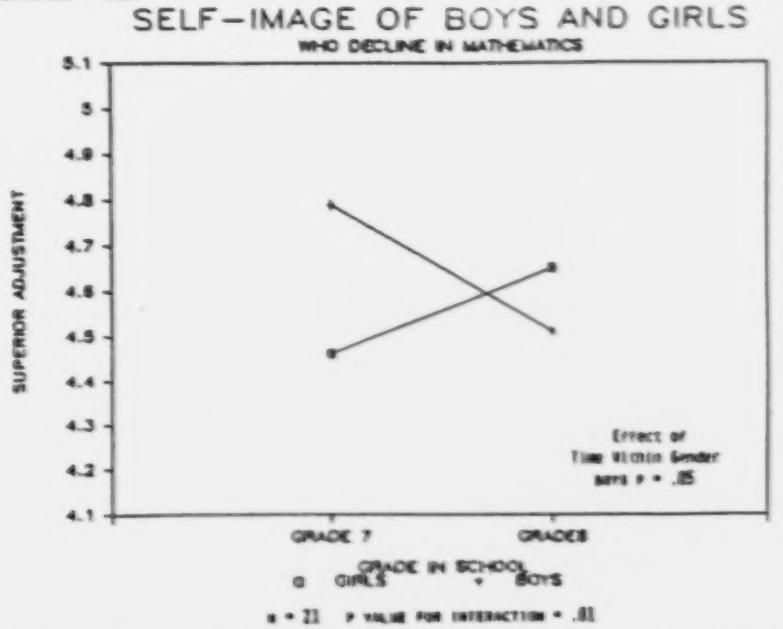


Figure 1. Gender differences in patterns of self-image change among students who dropped out of the high mathematics achievement group between seventh and eighth grade.